MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2022/2023

BMP2014 – MATHEMATICAL PROGRAMMING

(All sections / Groups)

7 JULY 2023
9.00 a.m – 11.00 a.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **THREE (3)** printed pages excluding cover page.
2. Answer **ALL FOUR (4)** questions.
3. Please write all your answers in the Answer Booklet provided.

QUESTION 1 (25 MARKS)

Determine an optimal table using **Two-Phase method** for the following Linear Programming problem:

$$\text{Minimize } Z = 3x_1 + 5x_2$$
$$\text{Subject to:}$$
$$2x_1 + 8x_2 \geq 40$$
$$3x_1 + 4x_2 \geq 50$$
$$x_1, x_2 \geq 0$$

QUESTION 2 (25 MARKS)

Consider the standard form LP:

$$\text{Maximize } Z = 10x_1 + x_2 + 2x_3$$
$$\text{Subject to:}$$
$$3x_1 + x_2 + x_3 = 8$$
$$4x_1 + 3x_2 + 4x_3 = 15$$
$$x_1, x_2, x_3 \geq 0$$

(a) Determine the direction of most rapid improvement in the objective function at any solution x. **(3 marks)**

(b) Compute the projection matrix **P** for the main equality constraints.
The formulae of $\mathbf{P} = \mathbf{I} - \mathbf{A}^T\left(\mathbf{A}\mathbf{A}^T\right)^{-1}\mathbf{A}$ and leave your answers in fractional form.
(15 marks)

(c) Apply your P to project the direction obtained in part (a).
Use these formulae: $\Delta\mathbf{x} = \mathbf{P}\mathbf{d}$ and leave your answers in fractional form.
(4 marks)

(d) Verify that Δx resulted in part (c) is improving at any interior point solution.
(3 marks)

Continued...

QUESTION 3 (25 MARKS)

(a) Consider the following linear programming model:

$$\begin{aligned} \text{Maximize} \quad & z = 3x_1 + 2x_2 + 5x_3 \\ \text{Subject to} \quad & x_1 + 3x_2 + 2x_3 \leq 15 \\ & 2x_2 - x_3 \geq 5 \\ & 2x_1 + x_2 - 5x_3 = 10 \\ & x_1 \geq 0, x_2 \geq 0, x_3 \geq 0 \end{aligned}$$

And its optimal table is:

Row	z	x_1	x_2	x_3	s_1	s_2	a_2	a_3	RHS	BV
0	1	0	0	0	51/23	58/23	M-(58/23)	M+9/23	565/23	$z = 565/23$
1	0	0	0	1	4/23	5/23	-5/23	-2/23	15/23	$x_3 = 15/23$
2	0	0	1	0	2/23	-9/23	9/23	-1/23	65/23	$x_2 = 65/23$
3	0	1	0	0	9/23	17/23	-17/23	7/23	7/23	$x_1 = 120/23$

Find the dual for above model and state the duality optimal solution. What is the dual's objective function value?

(10 marks)

(b) Use the Lagrange Multiplier to find the optimal solution for the following model:

Minimize $Z = x_1^2 + x_2^2 + x_3^2$
subject to: $x_1 + 2x_2 + 3x_3 = 7$ and $2x_1 + 2x_2 + x_3 = {}^9/_2$

(15 marks)

Continued...

QUESTION 4 (25 MARKS)

(a) Normah Company has four technicians to be assigned to repair four machines for the clients. The cost of each technician repairing the machine is summarized in the table below:

Technician	Machine (RM)			
	E	F	G	H
Aru	24	18	27	23
Baizura	20	19	21	17
Kelvin	29	17	16	21
Din	13	18	17	19

Find the optimal assignment that will minimize the total cost. What is the total minimum assignment cost for Normah Company?

(6 marks)

(b) A furniture company is supplying a new type of computer tables from four factories to three warehouses. The transportation cost per unit in MYR from each factory to each warehouse is shown in the following tables:

Factory	Warehouse			Factory Capacity
	A	B	C	
W	12	10	6	500
X	4	15	3	700
Y	9	7	5	400
Z	11	8	6	700
Warehouse Demands	900	600	800	

Obtain a basic feasible solution using Minimum Cost method. Then, apply the transportation Simplex method to find the least-cost distribution system.

(19 marks)

End of Question.